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WINDROWING QUALITIES OF Co. 281 AND OTHER VARIETIES OF SUGARCANE UNDER LOUISIANA CONDITIONS[1]

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INTRODUCTION

Before the advent of the present commercial varieties of sugarcane in Louisiana, considerable cane was windrowed from November 15 to 20 in anticipation of freezing temperatures to avoid the heavy losses that sometimes occurred in badly frozen cane.[3] Whether windrowing is practical in any given season depends upon the weather, the size of the crop, the straightness of the cane, and whether or not there is a surplus of labor. Many planters feel that the losses incurred in such windrowing are a cheap form of insurance against the heavy losses that sometimes result from severe freezing. The early experience with the newer varieties showed that deterioration was generally too rapid in unfrozen windrowed cane to make it a profitable practice. New hope was injected into this situation when it was observed early after its introduction into Louisiana that Co. 281 possessed keeping qualities comparable to those of the old varieties such as D. 74, which had been extensively cultivated theretofore. This characteristic of Co. 281 was noted by Arceneaux in early tests with this variety at the Sugar Plant Field Station, Houma, La. In 1931 he published the results of a limited number of tests comparing the windrowing qualities of Co. 281 and of a few of the P.O.J. varieties (*1*).[4] It is the purpose of this circular to report the further findings of windrowing experiments with Co. 281, conducted during the 1930, 1931, and 1932 seasons at the United States Sugar Plant Field Station and the Southdown plantation at Houma, La.

[1] Presented before the sugar division of the American Chemical Society at Washington, D.C., Mar. 26–31, 1933.

[2] The authors appreciate the excellent cooperation received from officials of the Houma Sugar Co. (Southdown plantation).

[3] Windrowing of sugarcane to avoid the effects of freezing temperatures, as practiced in Louisiana, consists of cutting the canes at the base and laying the stalks of two rows in the furrow between the rows with the tops in the direction of the prevailing winds when possible. Care is exercised to see that the tops cover the stalks which are packed firmly in the furrows. The butts of the cane at the ends of the windrows are covered with cane trash.

[4] Italic numbers in parentheses refer to Literature Cited p. 14.

As an aid in evaluating the windrowing qualities of Co. 281, data on the windrowing of P.O.J. 36M and D. 74, under similar conditions, will also be presented. Although some data on windrowing of cane following the occurrence of rather severe freezing temperatures will be presented, which are supplementary to the experiments conducted during the season of 1929–30 by Rands, McKaig, and Bisland (*6*) of the Sugar Plant Field Station, Houma, La., this circular primarily concerns windrowing before freezes or after only slight freezes.

SAMPLING

Only straight cane of uniform stand, grown on limited areas and on soil of homogeneous character, was used. This procedure was followed to avoid as much as possible the variation in sucrose content. Even when this was done considerable variation was encountered, and a type of sampling designed to care for this variation was followed.

The data for 1930 were obtained by George Arceneaux, at the Sugar Plant Field Station, Houma, La. Windrowing was limited to the variety Co. 281, 1 lot of plant and 1 lot of second-year stubble cane being used. Five 40-stalk samples were taken at each of three places distributed over the area windrowed at each period of sampling. The localizing of the sampling was employed to avoid the error introduced by breaking the windrow when the stalks are drawn at random throughout the windrows.

During the season of 1931, two experiments were conducted, each involving the varieties Co. 281 and P.O.J. 36M. The method of sampling was the same in both cases. A block of 16 rows, 75 feet long, back of the first quarter drain and exclusive of the buffer rows, was used as a unit. Eight rows were windrowed and eight left standing. The standing and windrowed canes were divided into five equal sections along the rows. Four stalks were taken at random from each row of standing cane in each section. The 32 stalks from each section were combined into a sample. Eight stalks were also drawn at random from each windrow in each section and the stalks from each section combined into a 32-stalk sample. The same procedure was followed for each successive sampling. The samples were topped and stripped in the same manner as cane for the plantation mill.

During the season of 1932, in the experiment involving Co. 281, D. 74, and P.O.J. 36M, the cane consisted of five 200-foot rows of each variety in the same plot, exclusive of buffer rows and the cane in front of the first quarter drain. The varieties had been planted side by side in the spring. One hundred feet of each row was left standing and the remaining 100 feet windrowed. Starting on the one side of each variety plot, the first two rows were laid into a windrow with the tops lying in a southerly direction, the next two into a second windrow with the tops lying in a northerly direction, and the fifth row into a third windrow (one half the normal windrow) with the tops in a southerly direction. Two 30- or 40-stalk samples were taken from the butt end of each of the two double windrows and one sample from the butt end of the single windrow at each successive period of sampling. After the samples were taken the exposed butts were again covered with cane trash. Before taking the succeeding samples the cane lying on top was removed and discarded. Starting at the same side of the standing cane a sample was taken from each

end of the first and second pair of two rows, corresponding to the two double windrows, and half a sample from each end of the fifth row. The two half samples were combined to form one sample.

In the remaining experiments for 1932, a uniform procedure was followed. In any given test with each variety, six rows of cane 160 feet long constituted a unit, 80 feet of which was windrowed, giving three windrows with the tops lying in a southerly direction. One 40-stalk sample was taken from each end of each windrow at the end of the successive periods of storage. Before taking samples, except in case of the check samples, the exposed cane at the butt end of the windrows was removed and discarded. The butts were always re-covered with cane trash. At the same time a 40-stalk sample was taken at each end of the three pairs of rows of standing cane. All samples of cane were carefully weighed before milling in order that the percentage of extraction might be calculated.

PREPARATION OF SAMPLES AND DESCRIPTION OF METHODS OF ANALYSIS

As it was not practical to determine the composition of the whole cane, the analyses were confined to the juice, which was expressed by a three-roller, motor-driven mill. The juice from each sample of cane was separately collected and weighed, and 1 or 2 portions were taken for analysis. One portion was analyzed for its Brix reading, apparent sucrose, and apparent purity, the customary methods being employed.[5] The second portion of juice was composited with an equal volume of juice obtained from each of the 5 or 6 replicated cane samples; the composite sample of juice thus obtained was, after a preliminary treatment, subjected to a detailed analysis. Owing to the fact that other experiments were being conducted simultaneously it was not possible to make the detailed analysis as frequently as the determination of apparent sucrose and purity, which accounts for the greater number of the latter determinations.

Since cane juice as it comes from the mill contains appreciable quantities of extraneous material, such as cell tissues, wax, and soil, which rightfully should not be included in an examination of the juice phase, this material was removed from those samples subjected to the detailed analysis by centrifuging the juice in a solid-wall basket under standardized conditions, followed by straining through a 200-mesh screen. This simple means of removing the coarse suspended matter from cane juice was found to be effective, for, on allowing the juice to stand several hours, no appreciable quantity of material settled out.

The detailed analyses, which were made during the 1931 and the 1932 seasons, consisted of the following determinations:

Acidity: Determined by titrating 10 cc of juice with 0.1 N alkali, with phenolphthalein as an indicator.

pH: Determined electrometrically, employing the quinhydrone electrode against a saturated calomel electrode (*5*).

Dry substance: Determined by drying 8 g of juice (measured by pipetting 10 cc of diluted juice containing 80 g juice per 100 cc) on silica sand, at 70° C. in vacuum, according to the official method of the Association of Official Agricultural Chemists (*3, p. 364*).

[5] These analyses were performed by R. B. Bisland, of the Division of Sugar Plant Investigations, Bureau of Plant Industry, at the Sugar Plant Field Station, Houma, La., to whom the authors are indebted.

True sucrose: Determined by double polarization method, employing invertase as the hydrolytic agent, in accordance with the official method of the Association of Official Agricultural Chemists (*3, p. 370*). Initial solution contained 78 g juice/100 cc. Dry basic lead acetate was used as the clarification agent and anhydrous Na_2CO_3 as the deleading agent.

Reducing sugars as invert sugar: Reducing sugars were determined in the samples analyzed during the 1931 season by the Herzfeld method (*3, p. 382; 7, p. 240*), employing Meissl-Hiller factors; the samples during the 1932 season were analyzed according to the Lane-Eynon method (*3, p. 377; 7, p. 250*), which is greatly to be preferred. During the 1931 season, clarification of the samples was effected by filtration with the aid of diatomaceous earth, and during the 1932–33 season, by means of neutral lead acetate, followed by deleading with a dry mixture composed of 3 parts of sodium oxalate and 7 parts of potassium dihydrogen phosphate. The latter deleading mixture is preferred to a solution containing an oxalate and phosphate, such as is recommended by Cook and McAllep of Hawaii (*4*), and adopted officially by the Association of Hawaiian Sugar Technologists (*2*), as it obviates aliquoting and the introduction of a dilution factor in the calculation.

Ash: Determined by direct incineration of 20 g of juice at low red heat in platinum dishes.

Organic nonsugars: Determined by subtracting the sum of the total sugars and ash (based on dry substance) from 100. Obviously there are included in these data the accumulated errors of the four determinations involved, consequently little emphasis can be given them.

DISCUSSION

From knowledge accumulated through years of experience in Louisiana, it is generally accepted that weather conditions play a very important part in the deterioration of windrowed cane; cool, damp weather has been noted as being the most suitable. Dampness in combination with high temperatures promotes germination of the cane if the buds have not been killed previously by freezing, or promotes activity of micro-organisms if the cane has been damaged seriously. In view of other experiments conducted by the writers in which temperature and moisture conditions have been controlled, it can be assumed that deterioration of windrowed cane is most rapid when the weather is dry, the temperature usually being of less importance. It is fortunate that the weather conditions at the time of the year when windrowing is necessary are generally such that maximum deterioration does not take place.

During the period of the experiments conducted in 1930–31, the weather was predominantly cloudy, damp, and cool. The average maximum temperature was 62.8° F. and the average minimum, 42.5°; the rainfall was 7.10 inches. A temperature below 32° was recorded eight times, with 26° as the minimum, which occurred on December 23.

In table 1 are shown the weather conditions for the last two seasons. The average data for each of the two experiments conducted in 1931 are given separately. The temperatures were taken from the records of the United States Weather Bureau, at Southdown plantation, Houma, La. In both experiments the weather was predominantly cloudy and warm, which caused some root growth at the base of the stalks in the windrowed cane and also caused the tops of about 25 percent of the cane to turn upward at an angle of about 45°. There was, however, no evidence of bud growth (germination). During the season of 1932–33 cool, wet weather predominated. In November the minimum temperature fell below 32° F. on five occasions, the lowest recorded at the Sugar Plant Field Station being 27°,

and at the United States Weather Bureau, at Southdown plantation, Houma, La., 29°. No continuous record was made so that it is not known how long the minimum temperatures were maintained. These freezing temperatures, however, killed a large number of the terminal and a few of the lateral buds, and also badly damaged the leaves of the standing cane. On December 17 a minimum temperature of 24.5° was recorded at the Sugar Plant Field Station; at the Southdown plantation the temperature was 25°, which was sufficiently low to kill about 90 percent of the lateral buds, and to give the interior of the cane in many instances a water-soaked appearance. No evidence of splitting was observed, however.

TABLE 1.—*Weather conditions during tests, seasons 1931–32 and 1932–33*

SEASON 1931–32

Date	Rainfall	Temperature			Sky
		Max.	Min.	Mean	
1931	*Inches*	*° F.*	*° F.*	*° F.*	
Nov. 20	0.88	74	58	66	Cloudy.
Nov. 21	.02	80	60	70	Do.
Nov. 22	0	81	66	73.5	Partly cloudy.
Nov. 23	0	82	64	74	Cloudy.
Nov. 24	0	80	67	73.5	Do.
Nov. 25	0	65	62	63.5	Do.
Nov. 26	0	77	53	65	Clear.
Nov. 27	.05	77	67	72	Cloudy.
Nov. 28	0	75	60	67.5	Do.
Nov. 29	.02	82	63	72.5	Partly cloudy.
Nov. 30	.21	83	67	75	Do.
Dec. 1	.33	62	50	56	Do.
Dec. 2	.32	55	48	51.5	Cloudy.
Dec. 3	.02	75	55	65	Do.
Dec. 4	0	65	50	57.5	Partly cloudy.
Dec. 5	0	66	43	54.5	Do.
Dec. 6	.03	61	48	54.5	Cloudy.
Dec. 7	.06	58	51	54.5	Do.
Dec. 8	4.72	70	48	59	Do.
Dec. 9	0	59	50	54.5	Partly cloudy.
Dec. 10	0	80	48	64	Clear.
Dec. 11	0	83	67	75	Do.
Dec. 12	0	81	65	73	Do.
Dec. 13	0	80	70	75	Do.
Dec. 14	.51	63	62	62.5	Partly cloudy.
Dec. 15	0	57	48	52.5	Cloudy.
Dec. 16	.05	60	54	57	Do.
Dec. 17	.11	80	62	71	Do.
Dec. 18	1.54	73	57	65	Do.
Dec. 19	.64	73	65	69	Do.
Total or average Nov. 20–Dec. 17	7.33	71.8	57	64.5	
Total or average Nov. 30–Dec. 19	8.54	69	65	62	

SEASON 1932–33

1932					
Nov. 12	0	57	30	44	Clear.
Nov. 13	0	67	29	48	Do.
Nov. 14	0	71	31	41	Partly cloudy.
Nov. 15	0	77	58	68	Cloudy.
Nov. 16	.08	55	47	51	Clear.
Nov. 17	0	51	34	43	Partly cloudy.
Nov. 18	1.30	44	40	42	Cloudy.
Nov. 19	0	59	31	45	Clear.
Nov. 20	0	69	33	51	Do.
Nov. 21	0	79	41	60	Do.
Nov. 22	0	77	44	61	Do.
Nov. 23	0	76	47	62	Do.
Nov. 24	1.95	71	57	64	Cloudy.
Nov. 25	0	59	47	53	Do.
Nov. 26	0	68	47	58	Partly cloudy.
Nov. 27	0	57	36	47	Clear.

TABLE 1.—*Weather conditions during tests, seasons 1931–32 and 1932–33*—Con.

SEASON 1932–33—Continued

Date	Rainfall	Temperature			Sky
		Max.	Min.	Mean	
1932	*Inches*	° *F.*	° *F.*	° *F.*	
Nov. 28	0	54	36	45	Clear.
Nov. 29	0	60	33	46	Do.
Nov. 30	0	70	29	50	Do.
Dec. 1	0	72	33	53	Do.
Dec. 2	0	74	38	56	Do.
Dec. 3	0	76	43	56	Partly cloudy.
Dec. 4	0	76	56	66	Do.
Dec. 5	0	74	51	63	Do.
Dec. 6	1.12	68	57	63	Cloudy.
Dec. 7	0	67	52	60	Partly cloudy.
Dec. 8	0	70	51	61	Cloudy.
Dec. 9	0	73	52	63	Partly cloudy.
Dec. 10	0	74	53	64	Do.
Dec. 11	0	70	56	63	Do.
Dec. 12	0	62	55	59	Do.
Dec. 13	0	81	55	68	Do.
Dec. 14	.35	76	59	68	Cloudy.
Dec. 15	.05	51	49	50	Do.
Dec. 16	.15	42	41	42	Do.
Dec. 17	0	36	25	31	Partly cloudy.
Dec. 18	0	37	28	33	Cloudy.
Dec. 19	0	52	35	43	Partly cloudy.
Dec. 20	.63	60	42	51	Do.
Dec. 21	0	73	57	65	Do.
Dec. 22	0	78	64	71	Do.
Dec. 23	0	77	67	72	Do.
Dec. 24	.27	72	55	64	Do.
Dec. 25	.05	73	61	67	Cloudy.
Dec. 26	.62	63	55	59	Do.
Dec. 27	.50	65	60	63	Do.
Dec. 28	0	59	49	54	Partly cloudy.
Dec. 29	0	77	50	64	Do.
Dec. 30	.07	77	65	71	Cloudy.
Dec. 31	0	54	45	50	Clear.
1933					
Jan. 1	0	53	27	40	Do.
Jan. 2	0	57	30	44	Cloudy.
Jan. 3	0	74	46	60	Partly cloudy.
Jan. 4	0	74	45	60	Do.
Total or average	7.14	65.5	45.5	55.5	

The conditions under which the cane was windrowed during 1932 were as follows: Three varieties, P.O.J. 36M, D.74, and Co. 281, were windrowed on November 11 before the 27° F. temperature occurred, and windrowing of two varieties, P.O.J. 36M and Co. 281, was repeated on November 14 to determine whether there was any effect on the keeping qualities of the cane in windrow due to the exposure to these slight freezes while standing. Another test with the same two varieties was again made on December 19, 2 days after the more severe freeze (24.5°). In every case, when possible, cane adjacent to the windrowed lot was left standing, in order to note any changes which might take place in such cane. Only by comparing standing and windrowed cane can the most reliable information for determining the necessity of windrowing be obtained.

As a matter of interest, temperature readings within the windrow and the temperature of the surrounding air were obtained at 2-hour intervals (from 7 a.m. to 5 p.m.) over a 4-week period during 1932. These data are given in the form of the graphs shown in figure 1. As might be expected, variation in atmospheric temperature was con-

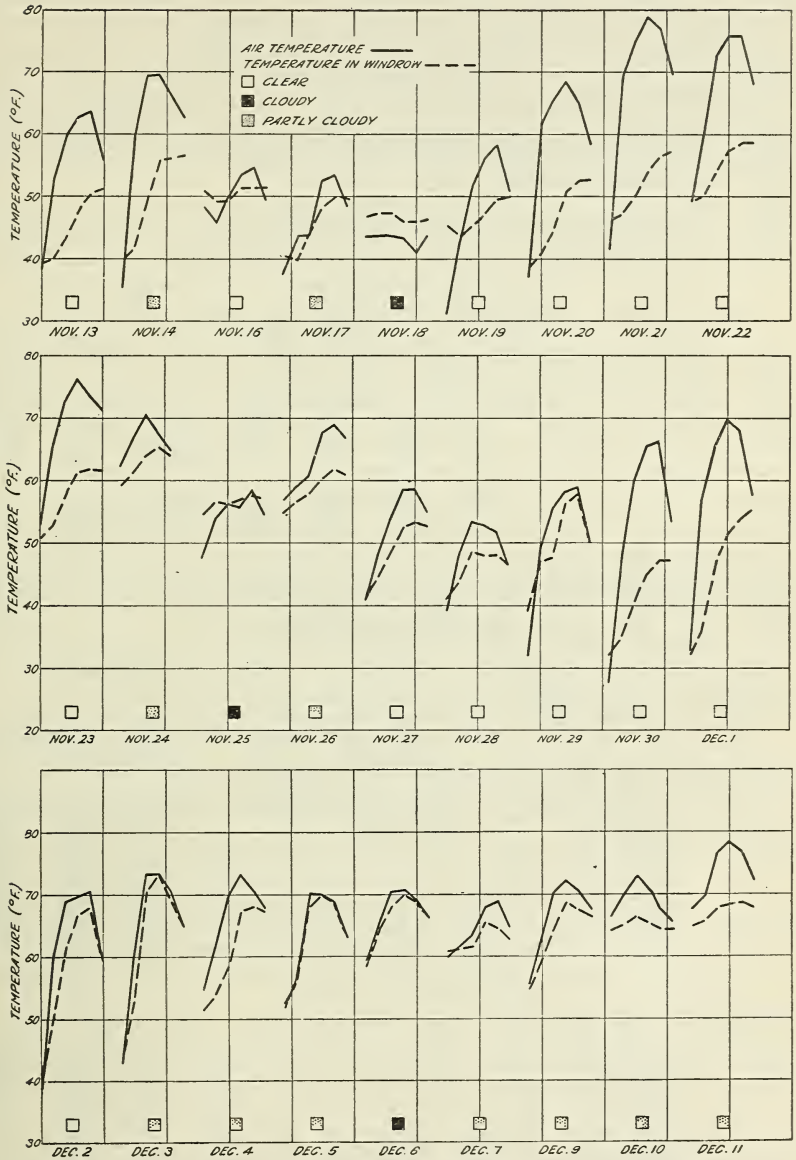

FIGURE 1.—Air temperature, temperature within the windrow, and clearness or cloudiness of sky.

siderably greater than variation in temperature in the windrow. At night, air temperatures were doubtless generally lower than those in the windrow, whereas the opposite was usually the case during the daytime. These results indicate that cane in the windrow is rather effectively insulated against the extreme variations in air temperature.

In tables 2, 3, and 4 are presented the Brix, apparent sucrose, and apparent purity of the juice expressed from windrowed cane, and, when available, also from standing cane. The percentage of juice extraction for the last two seasons' samples are also included in these tables. In each case these data are the average values for the 5 or 6 replicated samples of cane.

TABLE 2.—*Apparent purity data from windrowing tests with Co. 281, season 1930–31*

Date of analysis	Duration of experiment	Plant cane			Second-year stubble		
		Brix	Apparent sucrose	Apparent purity	Brix	Apparent sucrose	Apparent purity
1930	*Days*	°	*Percent*	*Percent*	°	*Percent*	*Percent*
Nov. 21	0	15.80	12.68	80.25	16.85	14.12	83.80
Dec. 1	10	17.07	12.64	74.05	17.51	13.44	76.76
Dec. 20	29	16.98	12.39	72.97	17.36	13.19	75.98
1931							
Jan. 6	46	17.02	12.57	73.86	17.08	13.03	76.29
Jan. 20	60	16.80	11.82	70.36	17.10	13.24	77.43
Feb. 5	76	17.10	12.62	73.80	17.00	13.30	78.24

TABLE 3.—*Apparent purity and extraction data from windrowing tests, season 1931–32*

CO. 281 PLANT CANE

Date of windrowing	Date of analysis	Duration of experiment	Standing				Windrowed			
			Brix	Apparent sucrose	Apparent purity	Juice extraction	Brix	Apparent sucrose	Apparent purity	Juice extraction
1931	1931	*Days*	°	*Percent*	*Percent*	*Percent*	°	*Percent*	*Percent*	*Percent*
Nov. 20	Nov. 19	0	--------	--------	--------	--------	15.70	12.70	80.89	57.0
	Nov. 25	6	--------	--------	--------	--------	16.11	13.00	80.69	62.4
	Dec. 4	14	--------	--------	--------	--------	16.73	13.14	78.54	60.0
	Dec. 11	21	--------	--------	--------	--------	16.40	13.06	79.63	60.0
	Dec. 18	28	--------	--------	--------	--------	16.22	12.81	78.98	61.3
Nov. 30	Nov. 30	0	13.64	10.17	74.56	60.4	13.71	10.06	73.38	62.6
	Dec. 9	9	14.46	10.86	75.10	56.7	14.94	10.67	71.42	56.7
	Dec. 14	14	14.62	11.28	77.15	59.1	14.78	10.67	72.19	57.8
	Dec. 19	19	14.84	11.39	76.75	60.6	14.47	10.00	69.11	57.7

P.O.J. 36M PLANT CANE

1931	1931									
Nov. 20	Nov. 19	0	--------	--------	--------	--------	15.48	12.35	79.78	57.4
	Nov. 25	6	--------	--------	--------	--------	15.97	11.90	74.51	63.0
	Dec. 4	14	--------	--------	--------	--------	16.05	11.14	69.41	58.8
	Dec. 11	21	--------	--------	--------	--------	15.77	11.03	69.94	58.2
	Dec. 18	28	--------	--------	--------	--------	15.39	11.00	71.47	61.6
Nov. 30	Nov. 30	0	12.02	8.10	67.39	58.8	12.21	8.16	66.83	62.0
	Dec. 9	9	13.12	8.98	68.44	59.1	13.32	7.33	55.03	56.0
	Dec. 14	14	12.91	8.87	68.71	60.6	13.38	7.22	53.96	60.2
	Dec. 19	19	13.36	9.27	69.39	60.9	12.97	6.81	52.50	63.0

TABLE 4.—*Apparent purity and extraction data from windrowing tests, season 1932–33*

Date of analysis	Duration of experiment	Standing				Windrowed			
		Brix	Apparent sucrose	Apparent purity	Juice extraction	Brix	Apparent sucrose	Apparent purity	Juice extraction
CO. 281 PLANT CANE									
1932	*Days*	°	*Percent*	*Percent*	*Percent*	°	*Percent*	*Percent*	*Percent*
Nov. 12	0	16.03	13.06	81.47	62.2	15.94	12.96	81.30	63.0
Nov. 18	7	16.55	13.40	80.97	64.7	16.50	13.15	79.70	67.5
Nov. 25	14	16.22	13.16	81.13	63.8	16.27	12.63	77.63	64.2
Dec. 2	21	16.76	13.84	82.58	62.4	16.27	12.82	78.80	63.3
Dec. 9	28	17.13	14.40	84.06	63.7	16.44	12.86	78.22	62.6
Dec. 16	35	17.14	14.26	83.20	63.6	16.29	12.61	77.41	62.1
Dec. 29	48	15.45	12.81	82.91	57.4	15.96	12.31	77.13	55.7
D. 74 PLANT CANE									
1932									
Nov. 12	0	14.17	10.91	76.99	66.6	14.40	11.19	77.71	66.4
Nov. 18	7	14.68	11.66	79.43	68.1	14.79	11.44	77.35	68.6
Nov. 25	14	14.50	11.40	78.62	67.2	14.68	11.24	76.57	66.5
Dec. 2	21	14.73	11.77	79.90	64.5	14.67	11.28	76.89	62.2
Dec. 9	28	------	------	------	------	------	------	------	------
Dec. 16	35	------	------	------	------	14.32	10.78	75.28	63.9
Dec. 29	48	------	------	------	------	------	------	------	------
P.O.J. 36M PLANT CANE									
1932									
Nov. 12	0	14.56	11.22	77.06	63.1	14.59	11.21	76.83	63.6
Nov. 18	7	14.63	11.35	77.58	63.8	14.78	10.65	72.06	64.5
Nov. 25	14	14.52	11.07	76.24	62.9	15.05	10.04	66.71	63.2
Dec. 2	21	14.72	11.18	75.95	61.6	15.10	10.32	68.34	60.5
Dec. 9	28	15.07	11.90	78.96	62.1	15.17	9.99	65.85	62.8
Dec. 16	35	15.22	11.96	78.58	62.0	14.99	9.95	66.38	61.2
Dec. 29	48	------	------	------	------	14.62	9.45	64.64	55.8
CO. 281 PLANT CANE									
1932									
Nov. 14	0	16.21	13.53	83.47	64.5	16.04	13.40	83.54	64.2
Nov. 23	9	16.28	13.48	82.80	63.5	17.01	13.90	81.72	64.2
Nov. 30	16	16.69	13.87	83.10	61.7	17.01	13.80	81.13	62.5
Dec. 7	23	17.07	14.31	83.83	64.0	17.09	13.80	80.75	64.5
Dec. 14	30	17.67	15.04	85.12	62.9	17.28	13.95	80.73	61.9
Dec. 23	39	16.99	14.28	84.05	64.6	17.07	13.38	78.38	65.9
1933									
Jan. 4	51	16.16	13.82	85.52	60.0	17.24	13.87	80.45	58.2
P.O.J. 36M FIRST-STUBBLE CANE (LOT 1)									
1932									
Nov. 14	0	15.82	13.21	83.50	62.0	15.73	13.07	83.09	60.9
Nov. 23	9	15.95	13.16	82.51	61.8	16.42	12.59	76.67	52.1
Nov. 30	16	16.09	13.35	82.97	59.2	16.59	11.84	71.37	59.8
Dec. 7	23	16.23	13.17	81.15	60.9	16.65	11.12	66.79	61.7
Dec. 14	30	16.58	13.83	83.41	58.0	16.67	11.32	67.91	58.6
Dec. 23	39	15.91	13.01	81.77	63.4	16.32	10.57	64.77	61.4
1933									
Jan. 4	51	15.16	12.60	83.11	52.3	16.08	10.51	65.36	56.1

TABLE 4.—*Apparent purity and extraction data from windrowing tests, season 1932–33*—Continued

P.O.J. 36M FIRST-STUBBLE CANE (LOT 2)

Date of analysis	Duration of experiment	Standing				Windrowed			
		Brix	Apparent sucrose	Apparent purity	Juice extraction	Brix	Apparent sucrose	Apparent purity	Juice extraction
1932	*Days*	°	*Percent*	*Percent*	*Percent*	°	*Percent*	*Percent*	*Percent*
Nov. 14	0	15.42	12.12	78.60	59.2	14.99	11.62	77.52	60.4
Nov. 23	9	15.31	12.18	79.56	60.6	15.47	11.45	74.01	60.4
Nov. 30	16	15.47	12.20	78.86	60.4	15.59	10.88	69.79	61.6
Dec. 7	23								
Dec. 14	30								
Dec. 23	39								
1933									
Jan. 4	51								

CO. 281 PLANT CANE

1932									
Dec. 19	0	17.98	15.84	88.10	58.9	17.79	15.52	87.24	60.4
Dec. 27	8	16.98	14.68	86.45	59.9	17.58	15.19	86.41	60.1
1933									
Jan. 4	16	16.56	14.33	86.53	57.5	17.17	14.99	87.30	58.7

P.O.J. 36M SECOND-STUBBLE CANE

1932									
Dec. 19	0	15.58	12.77	81.96	56.1	15.63	12.91	82.60	60.9
Dec. 27	8	15.61	12.80	82.00	59.4	15.41	12.72	82.54	60.4
1933									
Jan. 4	16	15.54	12.73	81.92	42.4	15.01	12.13	80.81	59.4

In table 2, in which first-stubble cane is compared with plant cane of Co. 281, there is indication that, although the differences are slight, maturity as judged by higher purity may have some influence on deterioration. This is partly substantiated in some of the subsequent experiments, as may be noted from the data in tables 3, 4, and 5. These data also show that the purity of the juice from a given lot of windrowed cane apparently reaches a minimum value which seems to have some relationship to the initial purity of the juice. When this stage is reached, the inversion of sucrose is apparently retarded to such an extent that the loss of sugars due to respiration keeps pace with any inversion that takes place.

TABLE 5.—*Detailed analyses of cane in windrowing tests, seasons 1931–32 and 1932–33*

STANDING CANE

Windrowed	Variety	Duration of experiment	Acidity (0.1 N alkali per 10 cc juice)	pH	Dry substance	True purity	Invert sugar [1]	Ash [1]	Organic non-sugars [1]
		Days	*cc*		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1931 Nov. 20	P.O.J. 36M	0	1.75	5.23	14.91	84.37	9.40	2.78	3.45
		14							
		28							
	Co. 281	0	2.20	5.19	15.39	86.87	5.61	3.13	4.39
		14							
		28							
Nov. 30	P.O.J. 36M	0	2.15	5.33	11.51	71.94	17.51	4.70	5.85
		14	1.95	5.27	12.29	75.26	14.72	4.43	5.59
	Co. 281	0	2.50	5.35	12.77	81.36	8.39	5.04	5.21
		14	2.40	5.24	13.76	84.08	6.47	4.66	4.79
		19	2.25	5.32	14.11	83.98	5.53	4.88	5.61
	P.O.J. 36M (plant cane)	0	2.20	5.35	14.08	83.24	9.60	3.02	4.14
		7	2.25	5.33	14.11	82.28	9.53	2.98	5.21
		21	2.25	5.32	14.30	81.33	10.29	3.26	5.12
		35	2.25	5.43	14.59	82.59	9.00	3.05	5.36
		48							
1932 Nov. 12	D. 74 (plant cane)	0	2.10	5.38	14.01	83.44	8.85	3.30	4.41
		7	1.80	5.41	14.21	84.10	8.00	2.73	5.17
		21	1.85	5.35	14.39	84.18	7.42	3.03	5.37
		35							
	Co. 281 (plant cane)	0	2.85	5.30	15.62	88.74	3.79	3.88	3.59
		7		5.31	15.69	87.06	4.21	4.04	4.69
		21	2.90	5.32	16.13	87.23	4.04	4.29	4.43
		35	2.80	5.44	16.38	88.40	3.12	3.88	4.60
		48	3.40	5.34	15.09	85.36	3.80	4.06	6.78
Nov. 14	P.O.J. 36M (first stubble) (Lot 1.)	0	1.80	5.29	14.97	83.57	8.34	3.10	4.99
		9	1.85	5.30	14.94	83.67	8.02	3.26	5.05
		16	1.90	5.26	14.99	83.19	8.79	3.28	4.74
	Co. 281 (plant cane)	0	2.10	5.28	15.76	87.37	4.35	3.09	5.19
		9	2.15	5.38	15.77	87.25	4.91	3.16	4.68
		16	2.20	5.29	16.18	87.70	4.40	3.12	4.78
		23	2.25	5.42	[2] 16.56	87.92	4.12	3.22	4.84
		51	2.40	5.41	15.84	88.32	3.43	3.24	5.01
Dec. 19	P.O.J. 36M (second stubble).	0	1.80	5.32	15.10	85.30	7.68	2.87	4.15
		16	1.70	5.45	15.24	86.81	7.38	2.47	3.34
	Co. 281 (plant cane)	0	2.40	5.30	17.50	91.31	1.82	3.03	3.84
		16	2.50	5.47	16.31	89.64	2.50	3.23	4.63

WINDROWED CANE

1931 Nov. 20	P.O.J. 36M	0	1.75	5.23	14.98	84.04	9.12	2.70	4.14
		14	1.80	5.31	15.56	75.81	16.30	2.82	5.07
		28	1.95	5.13	14.81	76.70	14.17	3.24	5.89
	Co. 281	0	2.20	5.23	15.05	86.45	5.93	3.25	4.37
		14	2.15	5.32	16.21	85.19	6.24	3.16	5.41
		28	2.30	5.23	15.49	84.44	6.24	3.54	5.78
Nov. 30	P.O.J. 36M	0	2.15	5.33	11.60	71.98	15.96	4.99	7.07
		14	2.15	5.31	12.63	61.94	26.05	5.17	6.84
	Co. 281	0	2.60	5.34	12.88	80.43	8.94	4.87	5.76
		14	2.60	5.31	14.00	79.43	9.34	4.72	6.51
		19	2.65	5.37	13.70	78.25	10.23	4.90	6.62

[1] On dry substance. [2] Calculated.

TABLE 5.—*Detailed analyses of cane in windrowing tests, seasons 1931–32 and 1932–33*—Continued

WINDROWED CANE

Windrowed	Variety	Duration of experiment	Acidity (0.1 N alkali per 10 cc juice)	pH	Dry substance	True purity	Invert sugar[1]	Ash[1]	Organic nonsugars[1]
		Days	*cc*		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1932 Nov. 12	P.O.J. 36M (plant cane)	0	2.20	5.33	14.11	82.85	10.25	3.12	3.78
		7	2.30	5.33	14.36	77.12	14.02	3.05	5.81
		21	2.30	5.32	14.80	73.24	18.06	3.15	5.55
		35	2.10	5.47	14.37	73.21	18.23	3.03	5.53
		48	2.10	5.39	14.13	71.97	18.29	3.22	6.52
	D. 74 (plant cane)	0	1.80	5.41	14.00	84.43	8.91	2.89	3.77
		7	1.95	5.41	14.29	84.05	9.04	2.91	4.00
		21	1.85	5.42	14.25	82.27	9.44	2.98	5.31
		35	1.80	5.47	13.75	81.85	10.00	3.02	5.13
	Co. 281 (plant cane)	0	2.85	5.30	15.49	88.41	3.86	3.97	3.76
		7	--------	5.31	15.76	85.73	5.36	3.86	5.05
		21	3.00	5.30	15.63	84.01	6.46	4.40	5.13
		35	2.85	5.44	15.47	83.71	7.25	3.94	5.10
		48	2.75	5.39	15.35	82.93	6.72	4.35	6.00
Nov. 14	P.O.J. 36M (first stubble) (Lot 1.)	0	1.85	5.28	14.55	82.06	9.68	3.32	4.94
		9	1.90	5.33	14.94	79.38	11.50	3.01	6.11
		16	2.00	5.26	15.12	75.60	15.56	3.39	5.45
	Co. 281 (plant cane)	0	2.10	5.28	15.59	87.52	4.41	3.18	4.89
		9	2.25	5.36	16.43	86.79	5.56	3.20	4.45
		16	2.30	5.28	16.61	85.61	6.17	3.02	5.20
		23	2.35	5.41	[2] 16.61	85.37	6.61	3.14	4.88
		51	2.15	5.40	16.83	85.11	6.84	2.94	5.11
Dec. 19	P.O.J. 36M (second stubble).	0	1.80	5.31	15.24	85.53	6.99	2.82	4.66
		16	1.70	5.47	14.79	84.65	7.72	2.70	4.93
	Co. 281 (plant cane)	0	2.45	5.32	17.20	90.96	2.14	3.14	3.76
		16	2.45	5.50	16.86	90.42	2.02	3.19	4.37

[1] On dry substance. [2] Calculated.

That inversion of sucrose is the principal change, exclusive of losses due to respiration occurring in sound cane after windrowing, is conclusively shown by the data presented in table 5. The acidity and hydrogen–ion concentration change but little during the period of windrowing the cane. The variations in the pH values are doubtless experimental and due to the fact that the apparatus was located in a room the temperature of which unavoidably changed rather abruptly at times. It is probable that under these conditions, equilibrium of the calomel electrode had not always been reestablished at the time of making the determinations. In general, any loss of sucrose is practically accounted for in the form of invert sugar although there does appear to be a tendency toward an increase in the organic nonsugars, which might be regarded as resulting from physiological changes accompanying respiration.

These analyses show conclusively the great superiority of Co. 281 over P.O.J. 36M and indicate that this variety is very suitable for windrowing. In the one experiment in which D. 74 was used, the rate of deterioration was slightly less rapid in this variety than in Co. 281, but the difference was sufficiently small to place the two varieties in the same class as regards their keeping qualities in the windrow.

As a maximum safeguard against losses due to freezing, it would seem advisable to have a certain proportion of the crop in this excellent-keeping cane, which would be reserved for windrowing. The stubble crops of Co. 281 may be preferable on account of their greater maturity, if deterioration is to be kept at a minimum; how-

ever, this is contrary to general practice, for generally the stubble cane is the first to be harvested.

By comparing windrowed and standing cane for the season of 1932–33, it is evident that there was no real necessity for the planters to windrow their cane during November. In fact, the quality of the standing cane, in most instances, improved after the slight freezes that occurred during this month. The freeze of December 17, however, was sufficiently severe to cause a variable degree of damage to the cane standing at the time. The cane which was windrowed after this freeze showed little change in composition during the short period it was under observation. Certain other samples of cane, taken from the same lot of standing cane and stored under controlled conditions, showed considerable damage, and deterioration due to the action of micro-organisms quickly set in.

It should be stated that the planters did extensively windrow their Co. 281 cane during November 1932, and as the cane (mostly of the other commercial varieties) which was standing at the time of the freeze of December 17 was worked up in the factories, the purity and yield of sugar gradually, but very noticeably, decreased. Before all this cane was cut, however, a portion of the sugar-factory supplies consisted of windrowed Co. 281 cane, and as soon as the windrowed cane was used, a distinct improvement in factory operation was noted. At the end of the campaign, when the factories were operating practically exclusively on windrowed cane, daily yields as high as 180 pounds of sugar to the ton of cane were reported. This yield was approximately as good as at any time during the season.

The writers have refrained from calculating yields of sugar from the windrowed cane tested, which, however, is frequently done in similar reports. It was felt that the factors for converting hand-mill juice analyses to normal juice analyses, which have been determined on freshly cut cane, could not be used with any great assurance of accuracy when windrowed cane was involved. The drying out of the cane, and the gradual loss of sugars as a result of respiration, certainly must cause a sufficient change in the composition of the cane to necessitate the use of factors different from those used for fresh cane.

There is no practical means of determining the loss of water from the cane stalks while in the windrow because of the attached tops and leaves, but there is evidence that such a loss does occur. Invariably the Brix, or dry substance, of the juice extracted from windrowed cane increases during the initial periods the cane is in the windrow, which can only be interpreted as being due to a loss of moisture. Whether there is a corresponding increase in sucrose depends upon the rate of deterioration; in case of little deterioration the sucrose content of course also shows an increase. This fact is undoubtedly partly responsible for the high yields from windrowed Co. 281 cane reported by the factories during the 1932 season. In other words, it is possible to obtain a somewhat exaggerated yield of sugar from windrowed cane because of a loss of moisture and in spite of some deterioration. It may also be noted from the data that the Brix, or dry substance, reaches a maximum figure sometime during long windrowing periods, after which it usually decreases. It is believed that this decrease is partly due to the loss of sugars by respiration exceeding the slow continued loss of moisture and possibly in some instances partly to the adsorption of moisture due to rains.

SUMMARY

From tests which have been conducted over a period of 3 years, it is concluded that Co. 281 possesses such excellent keeping qualities when windrowed that it should become a very valuable cane for the planters of Louisiana. In comparison with P.O.J. 36M, Co. 281 has consistently shown the least deterioration, and it was found to be practically equal to D. 74, which was famed for its excellent keeping qualities.

These tests showed that deterioration in unfrozen cane is the loss of sucrose due to inversion, because, exclusive of the loss of sugars due to respiration, this is the principal change which occurs in the juice phase of sound cane after cutting. However, if cane is damaged by freezing or by insects, permitting abnormal activity by micro-organisms, other reactions may be detected.

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